

Serial No. 10/728,540
September 19, 2005
Reply to the Office Action dated June 23, 2005
Page 2 of 10

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

Claim 1 (currently amended): A method of producing a piezoelectric component comprising the steps of:

forming a plurality of piezoelectric elements having a vibrating portion and a bump on a substrate;

mounting the plurality piezoelectric elements on a mounting substrate having external terminals via the bumps by flip chip bonding such that the vibrating portions are opposed to the mounting substrate;

arranging a resin film on the mounting substrate having the plurality of piezoelectric elements mounted thereon;

sealing the plurality of piezoelectric elements by embedding the resin film between adjacent ones of the piezoelectric elements mounted on the mounting substrate;

hardening the resin film; and

splitting the mounting substrate by dicing to form individual piezoelectric components; wherein

the sealing step includes a step of hot-press bonding in which the resin film is heated, softened, and simultaneously pressed by a roller; and

in the step of hot-press bonding, the mounting substrate having the piezoelectric elements mounted thereon is fixed to a flat-surface stage for the step of hot-press bonding.

Serial No. 10/728,540
September 19, 2005
Reply to the Office Action dated June 23, 2005
Page 3 of 10

Claim 2 (original): A method of producing a piezoelectric component according to Claim 1, wherein in the step of hot-press bonding, the mounting substrate having the piezoelectric elements mounted thereon is passed between two rollers.

Claim 3 (canceled).

Claim 4 (original): A method of producing a piezoelectric component according to Claim 1, wherein in the sealing step, a step of pressing the resin film from the upper side thereof is carried out by a mold-frame after the step of hot-press bonding.

Claim 5 (original): A method of producing a piezoelectric component according to Claim 1, wherein in the sealing step, the step of hot-press bonding is carried out by a mold-frame after hot-press bonding step.

Claim 6 (original): A method of producing a piezoelectric component according to Claim 1, wherein in the sealing step, the step of hot-press bonding is repeated.

Claim 7 (currently amended): A method of producing a piezoelectric component according to Claim 4, wherein in the sealing step, after the step of pressing the resin film from the upper side thereof is carried out, the a further step of hot-press bonding and the a further pressing step are sequentially carried out, using the mold-frame.

Serial No. 10/728,540
September 19, 2005
Reply to the Office Action dated June 23, 2005
Page 4 of 10

Claim 8 (original): A method of producing a piezoelectric component according to Claim 1, wherein in the sealing step, the step of hot-press bonding step is repeated, and thereafter, a step of pressing the resin film from the upper side thereof is carried out by a mold-frame.

Claim 9 (original): A method of producing a piezoelectric component according to Claim 1, further comprising, disposing a resin-flowing-out preventing frame on the end portion of the mounting substrate after the arranging step.

Claim 10 (original): A method of producing a piezoelectric component according to Claim 1, wherein after the mounting step, at least one sealing-assisting piece is disposed between adjacent ones of the piezoelectric elements mounted on the mounting substrate.

Claim 11 (original): A method of producing a piezoelectric component according to Claim 10, wherein the at least one sealing-assisting piece is provided by bonding a sheet having plural openings to the mounting substrate.

Claim 12 (currently amended): A method of producing a piezoelectric component according to Claim 1, wherein before the mounting step, at least one sealing assisting piece is disposed between piezoelectric elements before the piezoelectric elements are mounted on the mounting substrate.

Serial No. 10/728,540
September 19, 2005
Reply to the Office Action dated June 23, 2005
Page 5 of 10

Claim 13 (currently amended): A method of producing a piezoelectric component according to Claim 12, wherein after the at least one sealing-assisting piece is provided by bonding of the a sheet having plural openings to the mounting substrate, piezoelectric elements are mounted onto the mounting substrate through the openings.

Claim 14 (original): A method of producing a piezoelectric component according to Claim 12, wherein a height of the at least one sealing-assisting piece is larger than a height of the bumps and is smaller than a height of the plurality of piezoelectric elements mounted by flip chip bonding.

Claim 15 (original): A method of producing a piezoelectric component according to Claim 1, wherein before the mounting step, the mounting substrate is surface-modification-treated to enhance the adhesion of the mounting substrate to the resin film.

Claim 16 (original): A method of producing a piezoelectric component according to Claim 1, wherein after the mounting step, the mounting substrate is surface-modification-treated to enhance the adhesion of the mounting substrate to the resin film.

Claim 17 (original): A method of producing a piezoelectric component according to Claim 15, wherein the surface-modification-treatment is carried out by at least one of plasma-irradiation, UV-irradiation, corona-discharge, excimer-laser irradiation, and sand-blasting.

Serial No. 10/728,540
September 19, 2005
Reply to the Office Action dated June 23, 2005
Page 6 of 10

Claim 18 (original): A method of producing a piezoelectric component according to Claim 1, wherein gaps between the plurality of piezoelectric elements mounted on the mounting substrate via the bumps by flip chip bonding and the mounting substrate are in the range of about 10 μm to about 50 μm .

Claim 19 (original): A method of producing a piezoelectric component according to Claim 1, wherein a distance D between the plurality piezoelectric elements mounted on the mounting substrate and a thickness t of the plurality of piezoelectric elements have a relationship expressed by $D/t > 2$.

Claim 20 (original): A method of producing a piezoelectric component according to Claim 1, wherein a height d of the piezoelectric component, a volume V of one of the plurality of piezoelectric elements including the bumps and the gap between the piezoelectric element and the mounting substrate, a number n of piezoelectric elements per unit area on the mounding substrate, a thickness t₁ of the resin film, and an average thickness t₂ of the mounting substrate (cross-sectional area/length of substrate) have a relationship expressed by $0.8 < d/(nV + t_1 + t_2) < 1.1$.

Claim 21 (original): A method of producing a piezoelectric component according to Claim 1, wherein the resin film has a volume-resistivity of up to about $10^{10} \Omega\cdot\text{m}$.

Claim 22 (original): A method of producing a piezoelectric component according to Claim 1, further comprising the step of forming an electroconductive layer on the back surface of a piezoelectric element after the mounting step.

Serial No. 10/728,540
September 19, 2005
Reply to the Office Action dated June 23, 2005
Page 7 of 10

Claim 23 (original): A method of producing a piezoelectric component according to Claim 1, further comprising the step of forming an electroconductive layer on the hardened resin film after the hardening step.

Claim 24 (original): A method of producing a piezoelectric component according to Claim 1, wherein the plurality of piezoelectric elements are surface acoustic wave elements having at least one interdigital electrode on the surface of a piezoelectric substrate.

Claim 25 (original): A method of producing a piezoelectric component according to Claim 1, wherein the plurality of piezoelectric elements are piezoelectric thin-film elements having a substrate with an opening or concavity and having a vibrating portion with at least one layer of a piezoelectric thin-film sandwiched between a pair of upper and lower electrodes opposed to each other and positioned over the opening or concavity.

Claims 26-32 (canceled).

Claim 33 (currently amended): A method of producing a surface acoustic wave device comprising the steps of:

forming a plurality of surface acoustic wave elements including at least one interdigital electrode and a bump formed on the surface of a piezoelectric substrate;

Serial No. 10/728,540
September 19, 2005
Reply to the Office Action dated June 23, 2005
Page 8 of 10

mounting the plurality of surface acoustic wave elements on a mounting substrate having external terminals via the bumps by flip chip bonding such that at least one interdigital electrode is opposed to the mounting substrate;

arranging a resin film on the mounting substrate having the plurality of surface acoustic wave elements mounted thereon;

sealing the plurality of surface acoustic wave elements by embedding the resin film between adjacent ones of the surface acoustic wave elements mounted on the mounting substrate;

hardening the resin film; and

splitting the mounting substrate by dicing to form the individual surface acoustic wave devices; wherein

the mounting substrate is surface-modification-treated by at least one of plasma-irradiation, UV-irradiation, corona-discharge, excimer-laser irradiation, and sand-blasting.

Claim 34 (original): A method of producing a surface acoustic wave device according to Claim 33, wherein the sealing step is a hot-press bonding step in which the resin film is heated to be softened and simultaneously pressed by a jig.

Claims 35-38 (canceled).